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SUMMARY REPORT

ON

WORK ORDER NO. VI,
TASK ORDER NO. KK

May 19, 1960

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50X1

May 19, 1960

Dear Sir:

This summary letter (report describes the work done under Work Order No. VI, Task Order No. KK, during the period from February 8 through May 7, 1960.

This research program was undertaken to study methods of utilizing domestic-garbage-disposer equipment or techniques to destroy classified paper in an office area without the operation being noticed by people outside the office. During the program, many companies manufacturing disposers were contacted, selected commercial disposers were tested with water and air as the flushing medium, and brief modifications were tried on one disposer. As a result of this work, it was found that several conventional domestic garbage disposers are capable of satisfactorily pulverizing paper and require a minimum amount of flush water. One disposer, 50X1 was found to do a good pulverizing job without the use of water; a constant flow of air provided by the revolving turntable "flushed" the pulverized paper from the disposer. All of the units had certain limitations for the proposed application. Based on our brief study, we believe that a disposer could be readily developed that would operate with air and would meet all of the objectives specified for the office application.

Background Information

On December 2, 1959, you and an associate visited our laboratories and witnessed a demonstration of the experimental air-film-cooled

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incinerator (Model 1) which was under development under Task Order No. Z, and also of a domestic sink-type garbage-disposer unit which had been set up, as received from the manufacturer, for a few cursory experiments.

In the experiments with the garbage-disposer unit, both water-soaked and dry paper was fed into the unit with and without additional water being introduced. The destruction was surprisingly complete; however, a few typed characters were still legible. Of course, the rate of destruction was generally low, and varied with the amount and the method of introduction of the water. Nevertheless, it appeared that modifications of this type of equipment and/or of the operating technique might result in complete destruction and in a usable rate of destruction.

During a discussion of these units and of paper destruction in general, a need was expressed for a small unit which could destroy paper in an office area without its operation being noticed by people outside the office. It was indicated that, under certain service conditions, a unit embodying the burning principles which underlie the Model 1 incinerator could not be utilized; however, it appeared that the potentialities of a domestic garbage-disposer unit might be exploited under such selected conditions. In this connection, most offices have electricity and water available in certain amounts, and the normal toilet facilities could possibly be used to dispose of the waste. Further, under these service conditions, only a small amount of paper would have to be destroyed.

As a result of the expressed need and the encouraging preliminary tests, you requested that we give consideration to a research program directed toward a preliminary investigation of the possibilities of using the domestic-garbage-disposer principle in connection with the above-indicated

problem. It appeared that such a program might include the examination of different disposer-unit designs, consultation with disposer manufacturers, the evolution of possible modifications of existing equipment in order to accomplish the desired results, and brief laboratory experiments to evaluate the most promising modification ideas. If such an effort led to encouraging results, a subsequent program might then be set up to investigate the most promising ideas in more detail.

You and your associate indicated that, for paper-destruction applications, an ideal unit based on the disposer principle would have the following characteristics:

(1) It would be small and compact enough to be carried by one man and to be pouchable.

(2) It would be highly reliable.

(3) It would handle crumpled and/or torn paper in quantities corresponding to the contents of 4 to 7 bags (25-pound-bag size) per working day maximum. (It is likely that normal quantities for destruction per working day would involve the contents of 1 to 3 bags.)

(4) It would be operable in a small office or toilet.

(5) It would not be aesthetically unattractive in appearance.

(6) It would have a loading hopper of some sort, so that constant hand feeding would not be required.

(7) It would operate on 110-volt, 50 to 60-cycle current.

(8) Its operation would not attract the attention of people outside the office or toilet.

(9) It would destroy the paper completely, so that not even one legible character would remain.

(10) It would require very little setting up or instrumentation (if any).

(11) It would provide for easy inspection of its interior after use.

(12) It would operate without a constant flow of water.

(13) It would produce waste which could be readily disposed of.

On February 8, 1960, Work Order No. VI, Task Order No. KK was undertaken, directed toward accomplishing the work outlined above.

Engineering Activity

The engineering activity consisted essentially of a literature survey, contacts with selected manufacturers, a study of several disposer designs, a laboratory evaluation of selected disposers using water and air as the flushing medium, and a laboratory evaluation of a few preliminary modifications on one unit.

Literature Survey

At the beginning of the project, the cursory work which had been done previously by our staff was reviewed briefly. A search was then made of the literature over the past 10 years for information on garbage disposers.

Very little information was found on paper grinding. Most of the available information dealt with the mass use of garbage disposers and the effect on city sewage-treatment facilities. The most helpful information was obtained from an article in the August, 1959, issue of "Consumer Report", which described their evaluation and rating of all major garbage disposers which were on the market. Those ratings are as follows:

(1) Acceptable, Very Good

[redacted] 50X1

(2) Acceptable, Good

Hotpoint, MW-15

Hotpoint, MW-12

Hotpoint, MW-11

General Electric, FA 60S

General Electric, FA 60R

(3) Acceptable, Fair

Wards Fairway, Cat. No. 530

Pioneer, D-56

Kelvinator, FDH-1

Frigidaire, FDZ-3

RCA-Whirlpool, ECD-330

National, 124A

In-Sink-Erator, 77

RCA-Whirlpool, EID-311

Frigidaire, FDZ-1

In-Sink-Erator, 17LC

Waste King, SH-7000

National, 744A

In-Sink-Erator, 27LC

(4) Not Acceptable

American Standard, AS-65

Chambers, CF-13

Sears Kenmore, Cat. No. 4170

Westinghouse, FD-10

Whirl-A-Way, SD70X

Youngstown, FWD-100

Contacts With Manufacturers

Although the above rating list was helpful, the particular requirements for paper grinding necessitated our contacting the manufacturers. A list was made up from the "Thomas Register" and the "Classified Directory of Appliance, Radio, and TV Manufacturers"; this constituted 30 domestic and commercial garbage-disposer manufacturers. These are given in Appendix 1. On the basis of company size, reputation, and location, 21 of these companies were selected and contacted by telephone. Discussions were held with personnel in the engineering departments of 18 of these companies concerning the feasibility of grinding paper with their respective disposers. Typical comments from these discussions are given below:

(1) Disposers use water primarily to flush the pulp out of the machine and down the drain. Water is not necessary for the grinding process.

(2) Disposers will not operate without a constant flow of water.

(3) Paper is a hard material and will require special metals for the cutting or grinding parts.

(4) Paper is very abrasive and a 25 per cent reduction in part life should be expected.

(5) The problem of feeding paper into the grinding chamber will be difficult.

(6) The time required to grind paper will depend on the extent to which the paper is saturated in the pre-soak period.

(7) The particle size will not be uniform.

(8) The particles must be small so that they will remain suspended in the water.

(9) Secondary blades will reduce the particle size.

(10) Pulp waste will tend to block sewer pipes.

(11) Irregularities in the sewer pipes will cause a pulp buildup.

Many of the manufacturers had experimented to some extent with the problem of grinding paper. Some were more sure of the capabilities of their units than were others. None of the manufacturers could provide test data on parameters such as particle size, rate of destruction, or water consumption, that would have been useful for our investigation. The manufacturers who presented definite recommendations concerning the use of their units for grinding paper are categorized as follows:

(1) Will Pulverize Paper

(a) Domestic Units

American Standard

Electro-Way

Frigidaire

General Electric

In-Sink-Erator

James Portable

Pioneer

Waste King

Whirlpool

Youngstown

(b) Commercial Units

Hobart

National

Somat

Toledo

Waste Master

(2) Will Not Pulverize Paper

Chambers

Hotpoint

Kelvinator

Westinghouse.

Disposer Designs

Although it was not possible, under this program, to make a detailed analysis of the designs of the different disposer units, detailed sales and engineering literature was obtained and studied. Besides the variations which existed in the size, weight, and chamber configurations, the basic difference in the various designs was in the cutter action. All of the cutter-action approaches could be placed in one of three general classifications:

(1) Grater - serrated cutters located on the turntable

(2) Shredder - fixed vanes located on the turntable

(3) Hammer mills - pivoted hammers located on the turntable.

To obtain some information on the reliability of the different designs, we contacted a local owner-operator of a well-established disposer service. He recommended the [redacted] above all others. His two main bases were that (1) competitive disposers are in need of repair generally in the second year of use, while the [redacted] generally needs no repair until the sixth or seventh year, and (2) the quality and workmanship of the [redacted] parts appear to be much better than those, respectively, of the other units. Although this information represented only one man's opinion, the work done during the remainder of the program tended to substantiate this view.

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Laboratory Tests Using Water

The formulation of a test program was governed by the requirements of the application and by the points brought out during discussions with the

manufacturers. Based on these factors, it was decided that the laboratory evaluation should provide information on (1) the time required to pulverize a given quantity of paper, (2) the minimum amount of water required to flush the paper pulp through the system, (3) the resultant particle size of the pulverized paper, (4) the method of feeding paper into the disposer, (5) the noise of the operation, and (6) the problems of waste-pulp disposal.

As shown in Table 1, six disposers were operated in the laboratory evaluation. These were selected on the basis of (1) cutter action, (2) rating in the "Consumer Report", (3) confidence shown by the manufacturer concerning paper destruction, and/or (4) our ability to obtain units on a loan basis. We believe that these six units represented the range in the ability of commercially available garbage disposers to pulverize paper.

Preliminary tests with these units suggested that the six factors of interest should be determined in the following manner. An 8-ounce quantity of paper should be fed into each unit in the manner which would best allow that unit to dispose of the paper, and the pulverization should be considered to be complete when no more pulp issued from the disposer. The minimum amount of water needed had to be established for each unit by several tests with different amounts of water. After considerable difficulty in trying to determine particle size, we devised a system based on the use of both typed copy and selected graph paper as the test material, in order to make the analysis of the waste fairly straightforward. The pulverized product was collected on wire screens and/or between glass plates. After visual inspection and study with a low-power magnifier, estimates were made as to the amount of fibers versus unpulverized material, and particle size. The best method of feeding paper for each unit had to be established by trial and

TABLE 1. TEST DATA FROM PAPER-DISPOSAL EXPERIMENTS USING WATER

	American Standard	Electro-Way	General Electric	In-Sink-Erator	Waste King	Waste King
Model Number	AS-65	EL 325	FC40TI	77	700	ILP-1
Feed Type	Continuous	Batch	Continuous	Continuous	Continuous	Continuous
Cutter Action	Grater	Shredder	Hammer mill	Shredder	Hammer mill	Hammer mill
OD, inches	7-1/2	8-3/4	6-1/2	6-5/8	8	9-7/8
Height, inches	10-3/4	18-1/2	14-1/2	12	14-3/4	15-7/8
Weight, pounds	22-1/2	42	19-1/2	22	24	30
Horsepower	1/3	1/3	1/3	1/3	1/4	1/3
Retail Price	$88.00	$185.00	$65.00	$90.00	$49.00	$130.00
Paper - Main Test	Regular office file, originals, copies; 8-1/2 x 11					
Quantity	8 ounces, net weight					
Preparation	Paper torn into quarters; dipped into water					
Paper Particle Test	Various graph paper - bond, tracing; colors - red, blue, green; 9 sheets					
Feeding Form	Crumpled wad	Folded	Crumpled tube	Crumpled wad	Crumpled wad	Crumpled tube and wad
Particle Analysis						
% Fiber	50	60	58	55	70	65
% Other	50	40	42	45	30	35
Over-all Size	Large	Medium small	Medium	Medium	Small	Small
Maximum Size, inch	3/8 x 1	3/8 x 3/4	1/2 x 7/8	1/2 x 1/2	3/8 x 5/8	1/4 x 7/8
Test Duration, minutes	6-1/4	4-1/2	3-1/4	4	5-1/2	3-1/4
Water Used, pints	36-1/2	17-1/3	20-1/2	24	20-1/3	14-1/2
Chamber Condition	Numerous particles	Some particles	A few particles	A few particles	Clean	Clean
Plumbing Condition	Pulp on wall of "L" tube	Clean	Particles in water trap	Pulp on walls of "L" tube	Pulp on walls of "L" tube	Pulp on walls of "L" tube
Sound Intensity	Slightly loud	Quiet	Slightly loud	Loud	Quiet	Very quiet
Trouble	Unwadded paper would not grind	Machine jammed	None	Unwadded paper would not grind	Overloaded	None
Comments	Spattered; required continuous flow	Batch feed objectionable	Impressive performance	Violent action; spattered	Mild spattering	Good performance; mild spattering

error. The noise evaluation could be done by ear, with the ultimate application in mind. The problems of waste disposal were investigated briefly by having the waste pulp pass through the pipe ("L" tube) connected directly to the disposer, through a conventional, domestic "P" trap, and then through a section of 2-inch sewer pipe before it was collected. Also, representative batches of waste were flushed down a standard toilet.

Table 1 shows the results of the test program. Because of the small particle size, quiet operation, easy method of feeding, and reliable operation, we believe that [redacted] is the best unit of those evaluated; however, any of the other units, except the American Standard, would be considered acceptable for the application of interest. 50X1

The results of this work were presented to you and your associates on April 5, 1960. It was concluded that, although the particle size was not as small as originally desired, the performance of [redacted] using water as a flushing medium was completely acceptable. 50X1

During that meeting, attention was also given to the problems of providing water to the disposer and of handling the messy water-pulp mixture. The desirability of being able to use air instead of water was discussed. Of all the manufacturers contacted, only one had thought that paper could be pulverized using air as the flushing medium. However, because this one manufacturer seemed to be quite confident in this regard, it was decided that the remaining project funds should be expended in an attempt to determine whether the operation would be feasible with air as the flushing medium.

Laboratory Tests Using Air

Because of its impressive performance with water, [redacted] was selected for the tests with air. Two types of tests were made to explore the best procedure to use with air. First, a constant flow of air through the disposer was provided by a tank-type vacuum cleaner which was attached to the outlet of the disposer. Second, the disposer was operated without any attachments. While the flow of air provided by the vacuum cleaner improved the rate of pulverization somewhat, the rest of the performance factors were actually better when no induced air flow was used. The primary results of the two tests are shown in Table 2.

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The main problem brought out during the experiments was that a small wad of paper would bounce around inside the chamber until worn down into particles. In the course of attempting to reduce the pulverizing time, some interesting results were obtained through minor changes in the grinding-chamber configuration. For example, the time required to grind one piece of wadded paper was between 1-1/2 to 2-1/2 minutes. By subdivision of the chamber into two parts by a piece of cardboard, 3 by 6 by 1/32 inch, inserted longitudinally, the grinding time was reduced to 45 seconds, and a slight decrease in the particle size also resulted. In another experiment, a 2-1/4-inch-diameter cardboard tube laminated on the outside with a No. 2 grade emery cloth was inserted in the chamber to within a vertical distance of 1/2 inch from the turntable; the total grinding time was reduced to 30 seconds and the paper was pulverized to microscopic size.

Insertion of the cardboard divider or the tube into the grinding chamber was judged to be rather awkward, and the resultant action of the machine was sufficiently violent to require that these parts be held in

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TABLE 2. TEST DATA FROM DRY PAPER-DISPOSAL EXPERIMENTS WITH A

Feed Type	Continuous		
Cutter Action	Hammer mill		
OD, inches	9-7/8		
Height, inches	15-7/8		
Weight, pounds	30		
Horsepower	1/3		
Price	$80.00 wholesale		
Paper	Office file, originals, copies, 8-1/2 x 11		
Quantity	8 ounces, net weight		
Preparation	10-15 sheets were precrumpled		
Feed Form	Individually crumpled paper wads		
	Vacuum Cleaner Coupled to Outlet	Disposer Alone	Blade Attached to Turntable
Particle Analysis			
% Fiber	60	85	97
% 1/64-1/32 inch	8	10	2
% 1/16-1/8 inch	30	4	1-
% Larger	2	1	Small amount
Maximum Size, inch	3/16 x 1/2	1/8 x 1/4	5/16 x 5/16
Test Duration, minutes	7	5-1/2	5
Chamber Condition	Small piece of paper remained	Small piece of paper remained	Clean except for some paper dust
Sound Intensity	Slightly loud	Loud	Very loud
Trouble	None	Overloaded	Overloaded
Comments	Performance very encouraging	Disposer could not be force fed	Motor must be air cooled

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position. It was believed that the grinding action could be considerably improved if a positive feed device were provided. A blade attached to the turntable was suggested; it was hoped that the blade would prevent any free bouncing and direct the paper wad against the shredders through centrifugal force. Several possible blade designs were fabricated and tested.

The most successful modification evolved as a result of this effort. In the design, the blade, 1/16 inch thick and 1-1/4 inch high, completely divided the turntable into two sections and was located approximately on a 90-degree angle to the two hammers. The ends of the blade were bent to an angle of 90 degrees, thus leaving an approximate 1/2-inch radial opening between them and the shredder wall. This radial opening was narrowed to about 1/16 inch by a 0.010-thick spring-steel plate attached to the blade. The plate deflected when a paper wad wedged against the shredder wall; and, as the paper was pulverized, the spring-steel plate returned to its original position and directed the remaining particles into the shredders. With this attachment, the [redacted] disposer ground a wad of paper completely and expelled the microscopic particles in 10 seconds. As shown in Table 2, 8 ounces of paper (approximately 45 sheets) were pulverized in 5 minutes with this arrangement. This time compared favorably with the grinding time of the disposers as shown in Table 1. 50X1

Future Work

Although encouraging results were obtained with the [redacted] 50X1
[redacted] using air and a modified turntable, the operation still had definite 50X1
limitations for the proposed office application. These consisted primarily of a poor feeding method, exceptionally noisy operation, and excessive motor

heating. Based upon our work, however, we believe that a satisfactory unit could be readily developed that would be based on the principles of a hammer-mill operation. The possibilities of such a development will be discussed in detail with you in the near future.

We have enjoyed working on this program for you. The fact that several disposers can be used satisfactorily with water and that a more easily used unit can probably be readily developed will be of significant value to you.

We would appreciate any comments which you or your associates might care to make with regard to this research.

Sincerely,

[redacted] 50X1

[redacted] 50X1

In Triplicate

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APPENDIX 1

LIST OF COMMERCIAL AND DOMESTIC GARBAGE-DISPOSER MANUFACTURERS IN THE UNITED STATES

(1)* American-Standard Plumbing and Heating Division
American Radiator and Standard Sanitary Corporation
40 West 40th Street
New York 18, New York

(2) APSCO Products, Incorporated
9855 West Pico Boulevard
Los Angeles 36, California

(3)* Chambers Built-Ins
2012 North Harlem Avenue
Chicago 35, Illinois

(4)* Electro-Magic Company
Columbus Division
2158 East Main
Columbus, Ohio

(5) Enterprize Engine and Machinery Company
600 Florida Street
San Francisco 10, California

(6) W. H. Fabry Manufacturing Company
Date and Orange Streets
Alhambra, California

(7) Food Waste Disposer Company
605 West Washington Boulevard
Chicago, Illinois

(8)* Frigidaire Division
General Motors Corporation
Department 2361
Dayton 1, Ohio

(9) Garb-el
Buffalo Hammer Mill Corporation
1243 McKinley Parkway
P. O. Box 3
Buffalo 18, New York

(10) Garbridder
Jeffrey Manufacturing Company
956 North 4th Street
Columbus, Ohio

(11)* General Electric Company
Appliance and TV Receiver Division
Appliance Park (Domestic)
Louisville, Kentucky

(12) W. T. Hedlund Company
4600 West Washington Boulevard
Los Angeles 16, California

(13)* Hobart Manufacturing Company
Troy, Ohio

(14)* Hot Point Company
5600 West Taylor Street
Chicago 44, Illinois

(15)* In-Sink-Erator Manufacturing Company
1225 14th Street
Racine, Wisconsin

(16)* James, Incorporated
1024 West Sycamore
Independence, Kansas

(17)* Kelvinator Division
American Motors Corporation
14250 Plymouth Road
Detroit, Michigan

(18)* National Disposer Plumbing Equipment Division
National Rubber Machinery Company
47 West Exchange Street
Akron 8, Ohio

(19) National Steel Construction Company
500 Myrtle
Seattle, Washington

(20)* Nelson Stamping and Manufacturing Company
115 East Carson Street
Pittsburgh 19, Pennsylvania
(Manufactures an electric incinerator)

(21)* Pioneer Manufacturing Company
3131 San Fernando Road
Los Angeles 65, California

(22)* Somat
Wandel Machine Company, Incorporated
Pomeroy, Pennsylvania
(Disposer is for large quantities of paper)

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(23)* Toledo
Division Toledo Scale Corporation
Toledo 12, Ohio

(24)* Tracy-American Kitchens
Division of Viclad Industries
3125 Dreble Avenue
Pittsburgh 33, Pennsylvania
(Handles parts only)

(25)* Waste King Corporation
3300 East 50th Street
Los Angeles 58, California

(26)* Waste Master
Lockley Machine Company
New Castle, Pennsylvania

(27) Wastexit
Salvator Company
118 Southwest Boulevard
Kansas City, Missouri

(28)* Westinghouse Electric Corporation
Major Appliance Division
300 Phillippi Road
Box 2199
Columbus 16, Ohio

(29)* Whirlpool Corporation
300 Broad Street
St. Joseph, Michigan

(30)* Youngstown Kitchens
Division of American-Standard Plumbing and Heating
Salem, Ohio
(See Item 1)

*Disposer manufacturers contacted.